

## Revision of types of several species of *Bembecia* Hübner, 1819 from northern Africa and southwestern Europe (Sesiidae)

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**Abstract.** The type specimens of *Sesia sirphiformis* Lucas, 1849 from Lac Tonga in Algeria and *Dipsosphesia megillaeformis* v. *tunetana* Le Cerf, 1920 **syn. n.** from the vicinity of Tunis were examined and found to be conspecific. *Bembecia sirphiformis* belongs to the *B. ichneumoniformis* (Denis & Schiffermüller, 1775) species group and is currently known only from northern Africa. Records from Sicily, Sardinia, Corsica, southern Italy, and Morocco (as *B. tunetana*) are here considered doubtful and may belong to other species. *B. astragali* (Joannis, 1909) **stat. rev.**, which was described from northern Spain and southern France and was previously considered conspecific with *B. sirphiformis*, actually appears not to be so closely related to *B. sirphiformis* and seems to belong to the *B. megillaeformis* (Hübner, 1813) species group. *B. igueri* Bettag & Bläsius, 1998 **syn. n.** from Morocco is now considered to be a synonym of *B. astragali*.

**Zusammenfassung.** Die Typusexemplare von *Sesia sirphiformis* Lucas, 1849 vom Lac Tonga in Algerien und *Dipsosphesia megillaeformis* v. *tunetana* Le Cerf, 1920 **syn. n.** aus der Umgebung von Tunis wurden untersucht und ihre Artgleichheit festgestellt. *Bembecia sirphiformis* ist eine Art der *B. ichneumoniformis* (Denis & Schiffermüller, 1775) Artengruppe und bisher nur von Nordafrika bekannt. Meldungen von Sizilien, Sardinien, Korsika, Süditalien und Marokko (als *B. tunetana*) sind zweifelhaft und wahrscheinlich anderen Arten zuzuordnen. Die bisher als konspezifisch mit *B. sirphiformis* angesehene, aus Nordspanien und Südfrankreich beschriebene *B. astragali* (Joannis, 1909) **stat. rev.** ist nicht unmittelbar verwandt, sondern gehört der *B. megillaeformis* (Hübner, 1813) Artengruppe an. Synonym zu *B. astragali* ist *B. igueri* Bettag & Bläsius, 1998 **syn. n.** von Marokko.

### Introduction

During the examination of Sesiidae types in the Muséum National d'Histoire Naturelle, Paris (MNHP), the author noticed a significant similarity between the type specimens of *Sesia sirphiformis* Lucas, 1849 and *Dipsosphesia megillaeformis* v. *tunetana* Le Cerf, 1920. This was also noted but not published by Ferdinand Le Cerf, documented by a handwritten label “*Dips. sirphiformis* Luc. v. *tunetana* Le Cerf, ♀ Type”, which was added by Le Cerf to one of the primary types of *D. megillaeformis* v. *tunetana*. This specimen, a female, was later selected as lectotype by Špatenka (1992). The similarity between the two taxa, *sirphiformis* and *tunetana*, is in conflict with the current understanding of *S. sirphiformis*, which is considered conspecific with *Sesia astragali* Joannis, 1909 (Špatenka et al. 1993, 1999). Only two of three primary types of *D. megillaeformis* v. *tunetana*, a male and a female, were found in the MNHP and were examined by Špatenka (1992). He dissected the genitalia of the male, designated the female as lectotype and listed it as subspecies of *Bembecia albanensis* (Rebel, 1918). Several years later, the genitalia of the lectotype were also dissected and *Bembecia tunetana* was treated as a distinct species by Bettag & Bläsius (1999). In agreement with

this conclusion, *B. tunetana* is listed with species rank on the Fauna Europaea website with the comment suggesting that "... taxonomic research is needed". The aim of this paper is to clarify the identity of the taxa in question. Unless otherwise noted, the material examined is from the collection of the author.

### Abbreviations and notation

MNHP	Muséum National d'Histoire Naturelle, Paris
NHMM	Naturhistorisches Museum Mainz
CRB	collection of Rolf Bläsius, Eppelheim, Germany
CDB	collection of the author

'21.vi./vii–viii.2005' means that larva(e) or pupa(e) were found on June 21 and the adults emerged in July and August.

### *Bembecia sirphiformis* (Lucas, 1849)

Figs 1–6, 13, 17

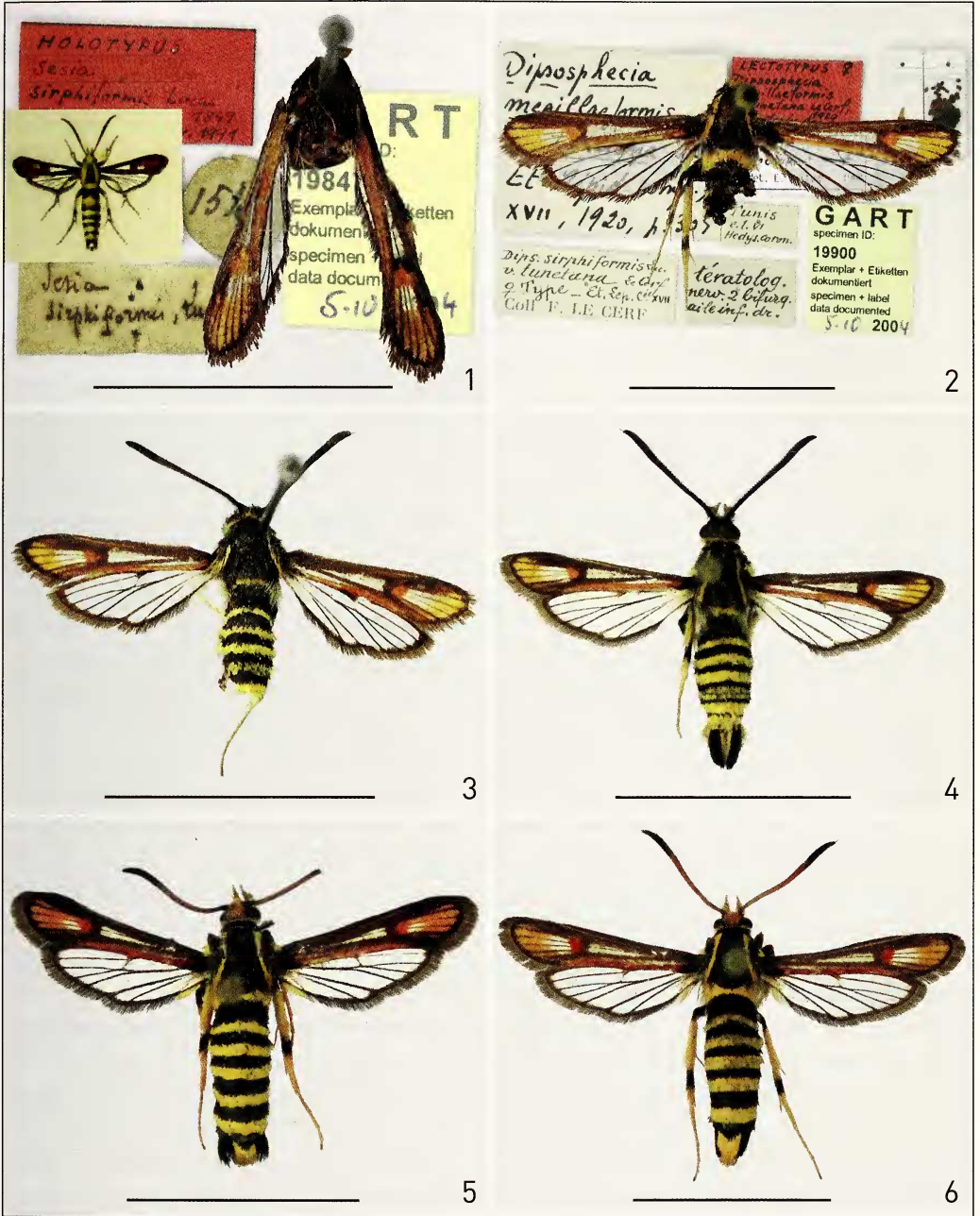
*Sesia sirphiformis* Lucas, 1849: 367. Syntype ♀ [without head and abdomen] (Fig. 1): "C'est en juin, dans les bois du lac Tonga, aux environs du cercle de Lacalle, que j'ai pris cette jolie petite espèce, dont je n'ai rencontré que deux individus." (MNHP).

**Material.** Syntype: 1♀ (Fig. 1), 'Sesia | sirphiformis, Luc.', '1544', 'Museum Paris', 'Holotypus | *Sesia* | *sirphiformis* Lucas | 1849 | K. Špatenka rev. 1991'. – **Italy, Sardinia:** 17♂, 21♀, Caglari, Villaputzu, Porto Corallo, larva/pupa reared from *Lotus creticus*, 21.v./v–vi.2004; 17♂, same data, pheromone; 11♂, 34♀, Caglari, Muravera, Stagno di Saline, larva/pupa reared from *Lotus creticus*, 26.v./v–vi.2004; 8♂, 5♀, same data, by net; 6♂, 2♀, Oristano, San Giovanni di Sinis, vic. Tharros, larva reared from *Lotus creticus*, 24.v./v–vi.2004; 5♂, Oristano, Stagno s'Ena Arrubia, 24.v.2004, pheromone; 1♂, Ogliastra, Bari Sardo, 18.vi.2009; 1♀, Nuoro, 5 km S Orosei, larva reared from *Lotus creticus*, 17.v./30.vi.2004; 28♂, 10♀, Ogliastra, vic. Arzana, larva reared from *Psoralea bituminosa*, 21.vi./vii–viii.2005; 78♂, same data, pheromone. **Italy, Sicily:** 3♂, 8♀, Madonie, vic. Polizzi Generosa, larva reared from *Psoralea bituminosa*, 15.v./vi–vii.2007; 3♂, 3♀, vic. Lercara, larva/pupa reared from *Hedysarum coronarium*, 16.v./v–vi.2007. **Morocco:** 5♂, 4♀, Middle Atlas Mts, Jbel bou Iblane, vic. Tafferte, larva reared from *Ononis spinosa*, 10.v./vi–vii.2006; 9♂, 2♀, same locality, 5.viii.1997; 7♂, 5♀, 10 km W Tiznit, larva reared from *Lotus creticus*, 18.v./vi–vii.2005; 2♂, same data, larva ii.2006; 1♂, 2♀, same data, larva v–vii.2005; 2♂, 10 km S Agadir, larva reared from *Lotus creticus*, vi.2005.

*Dipsosphesia megillaeformis* v. *tunetana* Le Cerf, 1920: 305 **syn. n.**, Lectotype ♀, des. Špatenka, 1992: 487 (Fig. 2): "Environs de Tunis, ex racines de Sulla, VI, coll. F. Le Cerf." (MNHP).

**Material.** 1♀ (Fig. 2) [lectotype of *Dipsosphesia megillaeformis* v. *tunetana* Le Cerf, 1920], 'Tunis | e.l. VI | Hedys. coron.' 'tératolog. | nerv 2 bifurq. | aile inf. dr.', '*Dips. sirphiformis* Luc. | v. *tunetana* Le Cerf | ♀ Type | Et. Lep. Cie. XVII | Coll. F. Le Cerf', '*Dipsosphesia* | *megillaeformis* | var. *tunetana* Le Cerf | Et. Lepid. comp., | XVII, 1920, p. 305', 'Lectotypus ♀ | *Dipsosphesia* | *megillaeformis* | v. *tunetana* Le Cerf, | 1920 | K. Špatenka des. 1991', '*Bembecia* | *tunetana* ♀ | det. E. Bettag 1998' [genitalia dissected, fixed on paper card and figured by Bettag & Bläsius (1999)]. – 1♂ (Fig. 3) [paralectotype of *Dipsosphesia megillaeformis* v. *tunetana* Le Cerf, 1920], 'chenille dans | racines de Sulla | eclos V-1911 | envoi de Tunis', '*Dipsosphesia* | *ichneumoniformis* F. | coll. F. Le Cerf ♂', '*Paralectotypus* ♂ | *Dipsosphesia* | *megillaeformis* | v. *tunetana* Le Cerf | 1920 | K. Špatenka des. 1991', '*Bembecia* | *tunetana* Le Cerf | R. Bläsius det. 11/1998' (MNHP). – **Tunisia:** 5♂ (Figs 4, 13), 4♀ (Figs 5, 6, 17), vic. Beja, 1–31.vii.2000, ex larva reared from *Hedysarum coronarium*, leg. R. Bläsius (CRB, CDB).

In his original description, Lucas (1849) mentions two specimens of *Sesia sirphiformis*, only one of which is currently deposited in the collection of the MNHP. This is a syntype and not the holotype as mentioned by Špatenka (1992). The second syntype may have been destroyed or lost a long time ago (Le Cerf 1920), thus my decision is to



**Figs 1–6.** Adults of *Bembecia sirphiformis* (Lucas, 1849), scale bar: 10 mm. **1.** ♀ syntype [insert: Original figure in Lucas, 1849]. **2.** ♀ lectotype of *Dipsosphesia megillaeformis* v. *tunetana* Le Cerf, 1920. **3.** ♂ paralectotype (MNHP). **4–6.** Specimens from Tunisia, vic. Beja, larva reared from *Hedysarum coronarium*. **4.** Male. **5.** Female, dark form with reduced LTA and small ETA. **6.** Female, pale form with small LTA and large ETA.

refrain from a lectotype designation. The remaining syntype is in a bad condition. The head, abdomen, and legs apart from the right hindleg are missing; the wings are not

spread making the hindwings incompletely visible. A lack of a longitudinal transparent area confirms the female gender of the specimen, despite the missing antennae and abdomen. The illustration of *Sesia sirphiformis* in Lucas (1849) (Fig. 1, insert) shows the tergites of the abdomen marked with five relatively consistent yellow posterior annulations. Females of *B. astragali* have only tergite 2, 4, and 6 with such complete yellow annulations and that on tergite 3 is indistinct or absent. Furthermore, the syntype of *sirphiformis* differs clearly from female specimens of *B. astragali* by the absence of a longitudinal transparent area (LTA), which is always present in both genders of *B. astragali*, and by the narrow external transparent area (ETA), consisting of three well-developed cells and mostly an additional very indistinct narrow cell (ETA distinctly broader, consisting of four well-developed cells in *B. astragali*).

The type series of *Dipsosphesia megillaeformis* var. *tunetana* was reared from larvae, which were found in the roots of *Hedysarum coronarium* (Fabaceae) (Le Cerf 1920). Since then, specimens that can be identified as conspecific without doubt have been collected only once. A series of five males and four females was reared by Bläsius from larvae found on *H. coronarium* in the vicinity of Beja, Tunisia. The females exhibit some variation in size and colouration, in the intensity of the forewing discal spot and in the extension of the transparent areas. The LTA is mostly absent, but sometimes very small, the ETA consists of 2, 3, or 4 partially very small cells (Figs 1, 2, 5, 6). The type localities of both *B. sirphiformis* and *D. megillaeformis* var. *tunetana* are separated by only about 200 km, and Beja is located almost in the middle. No other related species are known from this area. For the above reasons, *D. megillaeformis* var. *tunetana* is considered a synonym of *B. sirphiformis*.

*B. sirphiformis* appears to belong to the *B. ichneumoniformis* (Denis & Schiffermüller, 1775) species group and is closely related and habitually almost indistinguishable from *B. albanensis* (Rebel, 1918) from Southern and Central Europe, *B. handiensis* Rämisch, 1997 from Fuerteventura and Morocco, and *B. psoraleae* Bartsch & Bettag, 1997 from the Iberian Peninsula, southern France, and northwestern Italy. The males of *B. albanensis* have the yellow annulations less brilliant and more greyish. Small differences exist in the morphology of the genitalia. Male genitalia (Fig. 13) differ by the shape of the crista sacculi of the valva. In *B. sirphiformis* it has a short bald, apically directed ridge distally, which is lacking in *B. albanensis* (Fig. 14). The saccus is shorter and broader in *B. sirphiformis*. Furthermore, *B. sirphiformis* differs from *B. albanensis* and *B. handiensis* by the size of the medial crista of the gnathos, which is less prominent in *B. albanensis* and much bigger in *B. handiensis*. The females (Fig. 17) differ in the shape of the ostium bursae, which is y-shaped in *B. sirphiformis*, v-shaped in *B. psoraleae*, and with semi-circled lateral hemispheres in *B. albanensis* (Fig. 18), as well as the surface structure of the ante vaginal plate (densely grained, without folds in *B. sirphiformis* (Fig. 17, detail) and *B. albanensis* (Fig. 18, detail); scarcely grained, with strong folds in *B. psoraleae*). *B. psoraleae* differs further by a small sclerotised signum of the corpus bursae.

*Bembecia sirphiformis* (as *B. tunetana*) has been reported from northern Africa, Sicily, Sardinia, Corsica, and southern Italy (Bertaccini & Fiumi 2002; Laštůvka & Laštůvka 2001; Špatenka et al 1999). The European populations and specimens from

Morocco, reported by Bettag & Bläsius (1999), however, differ significantly in occurrence time and host-plant preference and have conspicuously different barcode sequences (Pühringer, in litt.). Therefore, the records of *B. sirphiformis* from Europe and Morocco are doubtful and may belong to other species. The relationships of the species in this complex and their distributions remain unclear and need further investigation.

***Bembecia astragali* (Joannis, 1909) stat. rev.**

**Figs 7–12, 15, 16, 19, 20**

*Sesia astragali* Joannis, 1909: 183. Lectotype ♀, des. Špatenka, 1992: 487 (Fig. 8): “Sur les collines entourant l'étang de la Bonde (par la Motte d'Aigues, Vaucluse)” (MNHP). ‘Cotype | exemplar dessiné | *Astragalus*, la Bonde (Vaucluse), 21.vii.08 | astragali | 1920–1932 coll. L. & J. de Joannis, Muséum Paris’ (Špatenka 1992).

**Material.** Paralectotype: 1♀ (Fig. 8), ‘Astragalus | la Bonde (Vaucluse) | 21 VII 08’, ‘P.E.L. Viette det. 19 | *Sesia* | astragali | Joannis’, ‘Paralectotypus ♀ | *Sesia astragali* | Joannis, 1909 | K. Špatenka des. 1991’ (MNHP). – Southern France, Provence: 7♂, 3♀, Dpt. Vaucluse, Rustrel, larva reared from *Astragalus monspessulanum*, 4.vi./vii.1992 (1♂, 1♀, Figs 9, 10; genitalia Figs 15, 20, two other specimens with the same data); 1♂, 1♀, same data, 27.vi./vii.1993; 7♂, 4♀, same data, 2.iv./vii–viii.1999; 1♂, same data, 27.vi./10.vii.2006; 1♂, 1♀, same locality; pupa reared from *Colutea arborescens*, 4.viii./viii.1993; 4♂, same locality, 5.viii.1993, pheromone; 2♂, Dpt. Drome, Montbrun les Bains, 28–30.vi.2006, pheromone; 2♂, Dpt. Drome, Col Aulan, 27.vi.2006, pheromone; 3♂, same data, 5.viii.1993; 3♂, same data, 25.vii.1992; 1♂, Dpt. Drome, Buis, Plaisians, 26.vii.1992, pheromone; 1♂, Dpt. Drome, Caseneuve, 3.viii.1993, pheromone; 1♂, Dpt. Vaucluse, Luberon, Cereste, 1.viii.1993, pheromone; 1♂, Dpt. Haut Alpes, Serres, Savournon, larva reared from *Astragalus monspessulanum*, 21.vi./vii.2010. **Spain**, Andalusia, Serrania de Ronda: 25♂, vic. Ronda, 24–28.vi.1993, pheromone; 6♂, Atajate, 24.vi.1994, pheromone; 8♂, Cortes de la Frontera, 19.vii.2004, pheromone; 3♂, el Burgo, 17–21.vii.2004, pheromone. **Italy**, Piemonte: 10♂, 13♀, Arquata Scrivia, Sottovale, ex larva reared from *Astragalus monspessulanum*, 30.v./vii–viii.2010. **Morocco**, High Atlas: 31♂, Tizi-n-Tichka, 10–11.vi.1996, pheromone; 8♂, Imilchil, Tizi-n-Tirhadouine, 26.vi.2008, pheromone; 4♂, Marrakech, Telouet, 26.vi.2008, pheromone; 1♂, Marrakech, Tizi-n-Fedrhat, 27.vi.2008, pheromone; 14♂, Ait Bou Guemez, Jbel M’Goun, 28.vi.2008, pheromone; 3♂, Tizi-n-Ouano, 2.vii.2008, pheromone; 1♂, 1♀ (Figs 11, 12), Iguer, larva reared from *Colutea atlantica*. Middle Atlas: 1♂, Jbel bou Iblane, 6.vii.2008, pheromone; Tizi-n-Ifar, 2♂ 6.vi.1999, 2♂ 16.vi.2007, pheromone; 1♀, same locality, larva reared from *Astragalus* sp.; 1♀, same locality, larva reared from *Colutea atlantica*. **Slovenia**: 1♂, vic. Koper, 20.vi.–23.vii.2003; 3♀, same locality, larva reared from *Genista tinctoria*, vii.2004. **Croatia**: 1♂, Krk, 10.vii.1996, pheromone. **Greece**: Pindos Mts: 6♂, Kastanea, 5.viii.2002, pheromone; 1♀, same data, ovipositing at *Astragalus glycyphyllos*; 4♂, Kranea, 6.viii.2002; 2♂, Timphristos, Fourni, 14.vii.2008, pheromone. 4♂, Timfi Mts, Vrissohori, Aaosbridge, 4.viii.2002, pheromone. Mitsikeli Mts: 11♀, Kopuati, larva reared from *Colutea arborescens*, 27.v./vii.1995; 2♀, Karyes, 31.v./vii.1995; 3♀, vic. Konitza, larva reared from *Colutea arborescens*, 3.vi./vii.1997.

*Bembecia igueri* Bettag & Bläsius, 1998: 71 **syn. n.**

= *Bembecia sirphiformis* sensu auctorum (nec. Lucas, 1849).

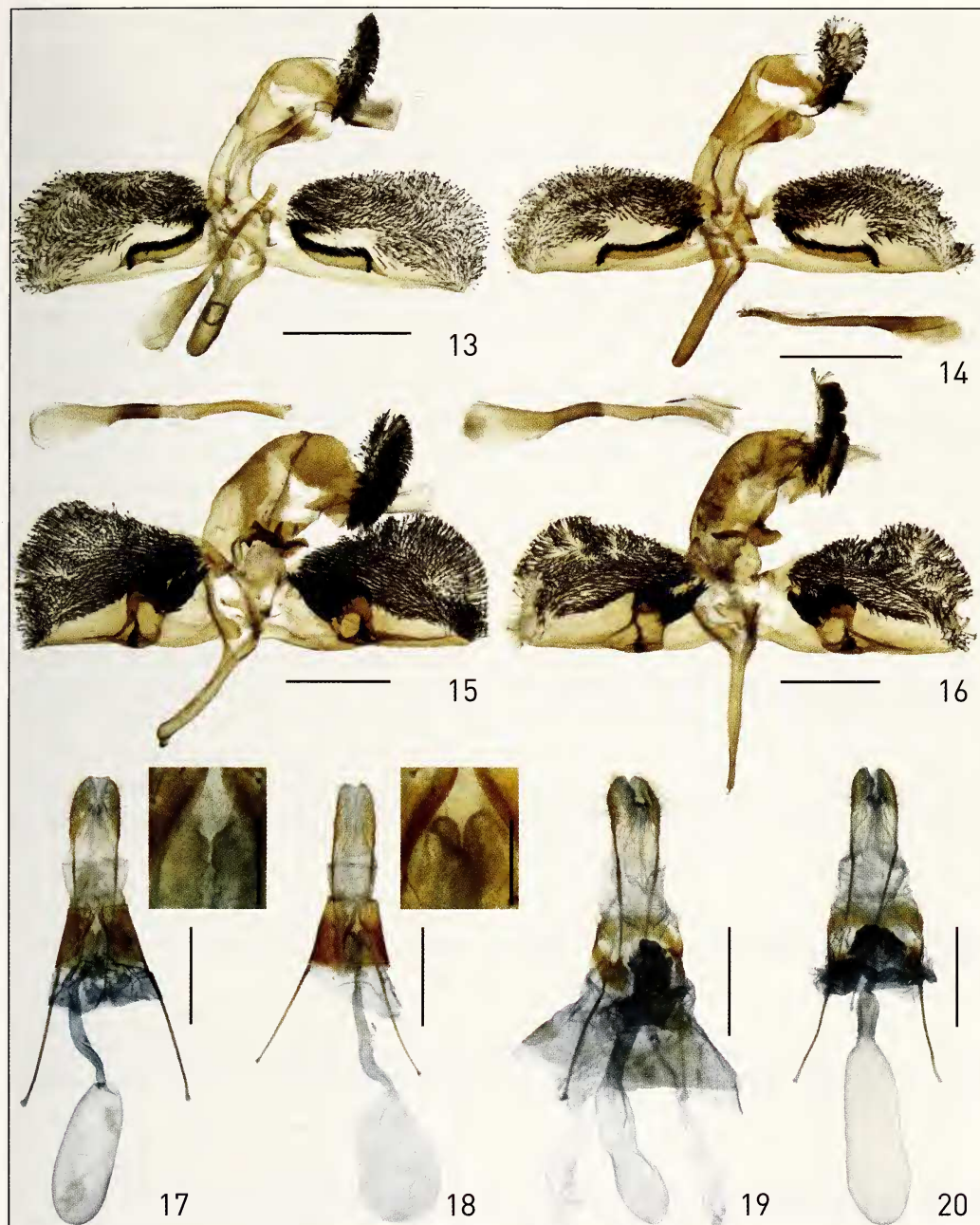
**Material.** 1♂ (Figs 7, 16), **Morocco** ‘Morocco / H. Atlas | Tizi-n-Test. 2100 m | 15.08.1997 | leg E. Bettag’, ‘Holotypus | *Bembecia igueri* | Bettag / Bläsius 1998’, ‘Nat. Hist. Museum | Mainz | E-2011/0425’ (NHMM). – 1♂, same data, ‘Paratypus, *Bembecia igueri* Bettag / Bläsius 1998’, ‘Nat. Hist. Museum Mainz E-2011/0426’ (genitalia Fig. 16) [dissected by Bettag] (NHMM).

*Bembecia astragali* was described from a series of three males and six females. All specimens except one female were reared from larvae that were found in southern France, la Bonde, Vaucluse, in rootstocks of *Astragalus monspessulanum* (Fabaceae). One female was collected at Montserrat, Barcelona (Joannis 1909). Only one of the female paralectotypes from la Bonde was actually found in MNHP (Fig. 8). *B. astragali* (as *B. sirphiformis*) is a well-known member of the *B. megillaeformis* (Hübner,



**Figs 7–12.** Adults of *Bembecia astragali* (Joannis, 1909). 7. ♂ holotype of *Bembecia igueri* Bettag & Bläsius, 1998 (NHMM). 8. ♀ paralectotype (without scale bar) (MNHP). 9–10. Male and female, France, Vaucluse, Rustrel, larva reared from *Astragalus monspessulanum*. 11–12. Male and female, Morocco, High Atlas, Iguer, larva reared from *Colutea atlantica*.

1813) species group (Bertaccini & Fiumi 2002; Freina 1997; Laštůvka & Laštůvka 1995, 2001; Špatenka et al. 1999). The genitalia, especially that of the males, are very



**Figs 13–20.** Genitalia structure of *Bembecia* species, scale bar: 1 mm; inserts (ostium details) scale bar: 0.2 mm. **13.** *B. sirphiformis* ♂, Tunisia, vic. Beja. **14.** *B. albanensis* ♂, Parnass Mts, Greece. **15.** *B. astragali* ♂, France, Rustrel. **16.** *B. astragali* ♂, Morocco, Tizi-n-Test (paratype of *B. igueri*, NHMM). **17.** *B. sirphiformis* ♀, Tunisia, vic. Beja. **18.** *B. albanensis* ♀, Markgröningen, Germany. **19.** *B. astragali* ♀, Morocco, Tizi-n-Test. **20.** *B. astragali* ♀ France, Rustrel.

homogeneous within this group and scarcely suitable for determination (Laštůvka & Laštůvka 2001). Larger specimens of *B. astragali* are very typical and unmistakable,

whereas small specimens can be confused with *B. iberica* Špatenka, 1992, which, however, has a very different morphology of the genitalia. The Moroccan *B. igueri* Bettag & Bläsius, 1998 syn. n. is here considered conspecific with *B. astragali*. It was described from a series of six males that were captured with the help of synthetic sexual pheromones at the Tizi-n-Test, in the western part of the High Atlas Mountains. A male and a female specimen from the type locality were reared by the author from larvae, which were found in rootstocks of *Colutea atlantica* (Fabaceae) (Figs 11, 12). This male and the specimens of the type series agree perfectly. They differ only marginally from typical French specimens of *B. astragali*, which were reared from *Colutea arborescens* and *Astragalus monspessulanum*. Males of *B. astragali* are strongly attracted by various synthetic pheromones and have been collected in large numbers. The males from Morocco show greater individual variation than specimens from Europe. The ground colour of the forewing, including the apical area, varies from nearly completely black to orange-yellow, and the discal spot is sometimes completely orange-yellow. The ETA can consist of four or five cells and its width is very variable, with occasionally only a very small apical area. The population of the Tizi-n-Test is in the southwestern extreme of the known range. Its representatives are generally somewhat darker with slightly smaller transparent areas and somewhat more prominent discal spots. Differences mentioned in the original description of *B. igueri* cannot be confirmed: “Arten der *Bembecia sirphiformis*-Gruppe [auctorum] unterscheiden sich am auffälligsten von der neuen Art und von *Bembecia megillaeformis* durch die kurze Stielung der Adern  $M_3$ - $Cu_1$  und durch lange Haarschuppen an den Vordercoxen [...]” (Bettag & Bläsius 1998). Investigation of several specimens of *B. megillaeformis* and *B. astragali* shows that the common stalk of veins  $M_3$ - $CuA_1$  varies much more in length as noted, broadly overlapping for both species. The long, hair-like scales of the forecoxa are common to all freshly emerged male specimens of *Bembecia*.

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